

ELECTRONICS TECHNICIAN
TRADE TECHNICAL INFORMATION SHEET

Algebra: Addition, Subtraction, Multiplication, and Division.

Mathematics is the language and tool of electronics. Algebra as a specific branch of mathematics is required more often to solve and understand problems encountered in electronics.

This information summarizes the fundamentals and is not intended to replace the regular text for the course.

General Definitions

Numerical algebraic expression = $9 + 10 - (5 + 3)$

Literal algebraic expression = $IR + E$

Product--result of multiplication

Numerical Coefficient
↓
 $2\pi fL = \frac{1}{2\pi fC}$
Factor Term

Evaluation--finding the numerical value of an algebraic expression.

example: $x=2, y=4, z=5$

$$2xyz = 2 \cdot 2 \cdot 4 \cdot 5 = 80$$

Z^2

Z = Base
 2 = Exponent or power

Monomial = axy

Binomial or polynomial = $ax + 2z$

Trinomial or polynomial = $ax + 2z - y$

Radical sign = $\sqrt{\quad}$

$\sqrt[3]{\quad}$ 3 = Index of root

Order of Operations

1. Multiplication--2. Division--3. Addition Subtraction

Addition and Subtraction

Rules for addition: 1. Like values--add their sum and prefix the common sign.

$$\text{example: } \begin{array}{r} +10 \\ +6 \\ \hline +16 \end{array}$$

2. Unlike values--find their difference and prefix the sign of the larger.

$$\text{example: } \begin{array}{r} -10 \\ +6 \\ \hline -4 \end{array}$$

Rule for subtraction: change the sign of the subtrahend and add algebraically.

$$\text{example: } \begin{array}{r} 100 \\ -40 \\ \hline 140 \end{array}$$

Addition of like terms $= 2ax + a = 3ax$

$$\begin{array}{r} \text{Addition of unlike terms } 2ax \\ 3az \\ \hline 2ax + 3az \end{array}$$

$$\begin{array}{r} \text{Subtraction of like terms } 2ax \\ -3ax \\ \hline 5ax \end{array}$$

$$\begin{array}{r} \text{Subtraction of unlike terms } 2ax - (3az) = 2ax \\ 3az \\ \hline 2ax - 3az \end{array}$$

Signs of grouping preceded by a + sign may be removed without any change. example: $r + (s - t) = r + s - t$

Signs of grouping preceded by a negative sign may be removed by changing the sign of every term in it.

$$\text{example: } r - (s - t) = r - s + t$$

Multiplication

Product of two like signs is positive $(x)(y) = xy$

Product of two unlike signs is negative $(x)(-y) = -xy$

Product of even negative signs is positive $(x)(-y)(-z) = xyz$

Product of odd negative signs is negative $(x)(y)(-z) = -xyz$

Product of powers with the same base--add the exponents $x^2 \cdot x^3 \cdot x = x^6$

Multiplication (cont.)

To multiply monomials:

First multiply numerical coefficients, second multiply these products by the product of the literal factors.

$$\text{example: } 2axy \cdot 3ax^2y = 2 \cdot 3 \cdot a^{1+1} \cdot x^{1+2} \cdot y^{1+1} \\ = 6a^2x^3y^2$$

To multiply a polynomial by a monomial:

Multiply each term of the polynomial by the monomial and add similar terms.

$$\text{example: } 2ax(4x+3x-5+x) = 8ax^2+6ax^2-10ax+2ax^2 \\ = 16ax^2-10ax$$

To multiply polynomials, multiply each term of the multiplicand by each term of the multiplier and add the products.

$$\text{example: } (2a+b)(a+2b) =$$

$$\begin{array}{r} a(2a+b) = 2a^2+ab \\ 2b(2a+b) = 4ab+2b^2 \\ \hline \text{add } 2a^2+5ab+2b^2 \quad \text{answer} \end{array}$$

Division

Rule: If both numbers are positive, the quotient is positive.

$$(+10) \div (+2) = +5$$

If both numbers have unlike signs, the quotient is negative.

$$(+10) \div (-2) = -5$$

Exponents


Rule: Any factor may be transferred from the numerator to denominator or vice versa by changing the sign of the exponent.

$$\text{examples: } \frac{x^2}{x^5} = x^{2-5} = x^{-3} \quad \frac{x^2}{x^{-5}} = x^{2+5} = x^7 \\ \frac{ax^2}{x^5} = \frac{a}{x^{5-2}} = \frac{a}{x^3}$$

Division of Monomials

Rule: Find value of the numerical coefficients, and write after them the value of the literal coefficients.

$$\text{example: } \frac{-10axz^4}{2a^2x^3z} = -5a^{-1}x^{-2}z^3$$



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Division (cont.)

Division of Polynomial by a Monomial

Rule: Divide each term of the dividend by the divisor and combine the results.

example:
$$\frac{10axy - 20a^2x^2y^3 - 4a^2x^2y}{2axy} = 5 - 10axy^2 - 2ax$$

Division of one polynomial by another

example:
$$\frac{30c^4 + 3 - 82c^2 - 5c + 11c^3}{3c^2 - 4 + 2c}$$

Rule 1. Arrange dividend and divisor in ascending or descending powers of some common literal factor:

$$30c^4 + 11c^3 - 82c^2 - 5c + 3 \mid 3c^2 + 2c - 4$$

Rule 2. Divide the first term of the dividend by the first term of the divisor and write as the first term of the quotient:

$$\frac{30c^4}{3c^2} = 10c^2 \quad \begin{array}{r} 3c^2 + 2c - 4 \\ 10c^2 \end{array}$$

Rule 3. Multiply entire divisor by the first term of the quotient, write product under dividend and subtract:

$$10c^2(3c^2 + 2c - 4) = \begin{array}{r} 30c^4 + 11c^3 - 82c^2 - 5c + 3 \\ 30c^4 + 20c^3 - 40c^2 \\ \hline -9c^3 - 42c^2 - 5c + 3 \end{array}$$

Rule 4. The remainder is a new dividend and repeat 2 and 3 until there is a remainder that cannot be divided:

$$\begin{array}{r} -9c^3 - 42c^2 - 5c + 3 \\ -9c^3 - 6c^2 + 12c \\ \hline -36c^2 - 17c + 3 \\ -36c^2 - 24c + 48 \\ \hline 7c - 45 \text{ remainder} \end{array} \quad \begin{array}{r} 10c^2 - 3c - 12 \end{array}$$

$$10c^2 - 3c - 12 \quad \frac{7c - 45}{3c^2 + 2c - 4} \quad \underline{\text{answer}}$$

